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SUPERSEDES
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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION SPECIFICATION

RECEIVER, PORTABLE, ILS

1. SCOPE

1.1 Scope. - The equipment specified herein is a portable, battery-operated receiver utilized in measuring the respective signal characteristics of instrument landing system (ILS) localizer and glide slope facilities. The equipment consists of a basic unit and separate antenna accessories for operation in either the localizer (VHF) or glide slope (UHF) bands of frequencies. All active electron devices shall be semiconductor devices.

2. APPLICABLE DOCUMENTS.

2.1 FAA specification. - The following FAA specifications, of the issues specified in the invitation for bids or request for proposals, form a part of this specification:

FAA-D-2494/1 Part 1	Instruction Book Manuscript Technical: Equipment and Systems Requirements: Preparation of Manuscripts
FAA-G-2100/1	Electronic Equipment, General Requirements; Part I, General Requirements for All Equipment
FAA-G-2100/3	Part 3, Requirements for Equipments Employing Semiconductor Devices
FAA-G-2100/4	Part 4, Requirements for Equipment Employing Printed Wiring Techniques
FAA-STD-013	Quality Control Program Requirements

FAA-G-2100/5	Part 5, Requirements for Equipments Employing Microelectronic Devices

(Copies of this specification, and of the applicable FAA specifications and drawings, may be obtained from the Federal Aviation Administration, Washington, D.C., 20591, ATTENTION: Contracting Officer. Requests should fully identify material desired, i.e., specification numbers, dates, amendment numbers, complete drawing numbers, in addition to the invitation for bids, request for proposals, contract involved, or other use to be made of the requested material.)

2.2 Military specifications. - The following military specifications, of the issues in effect on the date of the invitation for bids or request for proposals, form a part of this specification:

MIL-C-3098	Crystal Units, Quartz, General Specification
MIL-E-17555	Electronic and Electrical Equipment and Associated Repair Parts, Preparation for Delivery of
MIL-I-45208	Inspection System Requirements

(Information on obtaining copies of Military Specifications is given in Paragraph 1.2 of FAA-G-2100, Supplement 4, FAA List of Applicable Documents.)

3. REQUIREMENTS.

3.1 Equipment to be furnished by the contractor. - Each equipment furnished by the contractor shall be complete in accordance with all specification requirements and shall consist of the items tabulated below as specified in the contract schedule. Any feature necessary for proper operation in accordance with the requirements of this specification shall be incorporated in the equipment even though that feature may not be specifically described herein. Instruction books, in accordance with FAA-D-2494/1, shall be furnished in quantities specified in the contract schedule. A single instruction book shall cover all equipment items described herein which are furnished under the contract.

(a)	1 ea. Portable ILS Receiver	3.7
(b)	1 ea. Unipod, Localizer	3.8
(c)	1 ea. Antenna Assembly, Localizer	3.9.1
(d)	1 ea. Antenna Assembly, Glide Slope	3.9.2
(e)	1 set of interconnecting cables and adapters	3.10

(f) 1 ea. Carrying Case 3.11

(g) 1 ea. Tripod and Mast Assembly, Glide Slope 3.12

3.1.1 Crystal units. - Crystals shall be in accordance with MIL-C-3098. Crystal units that determine the operating frequency of the receiver shall not be furnished with the equipment. However, the contractor shall provide these units for test purposes (Section 4). Crystal units that are of identical value for all units, regardless of operating frequency, shall be provided.

3.2 DEFINITIONS.

3.2.1 DDM. - The term "DDM" refers to the difference in depth of modulation of the 90 Hz and 150 Hz components applied to the localizer or glide slope RF carrier. Values of DDM are obtained by subtracting the smaller modulation percentage from the larger and dividing by 100.

3.2.2 Standard localizer test signal. - A standard localizer test signal is defined as an RF carrier of 1000 microvolt level amplitude modulated simulataneously with 90 Hz and 150 Hz signals so that the sum of their separate modulation percentages equals 40 percent with the voltage waves of the 90 Hz and 150 Hz in positive--going zero phase each 1/30 second.

3.2.3 Standard glide slope test signal. - A standard glide slope test signal is defined as an RF carrier of 700 microvolt level amplitude modulated simultaneously with 90 Hz and 150 Hz signals so that the sum of their separate modulation percentages equals 80 percent with the voltage waves of the 90 Hz and 150 Hz signals in positive--going zero phase each 1/30 second.

3.2.4 Standard centering signal. - A standard test signal in which the DDM is less than 0.002.

3.2.5 Standard deviation signal. - A standard test signal, in which the DDM is as follows:

Localizer	0.165 ± 0.002
Glide Slope	0.165 ± 0.002

(In order to simplify testing it shall be permitted to utilize a DDM of 0.165 ± 0.002 for both localizer and glide slope applications.)

3.2.6 Service conditions. - Service conditions shall be as defined in Paragraph 1-3.2.23, FAA-G-2100/1 with 120 V AC (design center input and Environment II thereof except that the ambient temperature range shall be -20°C to + 50°C.

3.3 - NOT USED.

3.4 Output requirements.- Each portable ILS receiver shall provide the following output indications and signals:

3.4.1.- A visual indication of the battery voltage.

3.4.2.- A visual indication of the RF field intensity.

3.4.3.- A visual indication of the DDM of the input signal over the range of 0 to 0.50 at RF input levels over the range as specified in Paragraph 3.5.

3.4.4.- A demodulated audio output for use in analyzing the waveform of the modulation components.

3.5 RF input signals.- Unless otherwise specified, all performance requirements shall be met when a localizer or glide slope signal having the following characteristics is fed into the respective RF input jack of the equipment.

	Localizer	Glide Slope
Radio frequency	108.1 to 111.9 MHz	329.3 to 335.0 MHz
Input signal level	5 uV to 500 mV	25 uV to 500 mV
Amplitude modulation by 90/150 Hz	(see 3.2.2)	(see 3.2.3)
Voice modulation	50 percent (peak)	--
Identification modulation	5 percent	--

3.5.1 Overload protection.- The equipment shall not be damaged by RF input signals (3.5) at a level of 1.5 volts. This requirement shall be met on all positions of the input attenuator switch (if provided). (See Paragraph 3.7.1.2.5.)

3.6 Frequency channels.

3.6.1 Localizer frequencies.- In the localizer mode, each receiver shall be capable of operating on 20 frequencies (one at a time) within the range of 108.1 to 111.9 MHz based on a 50 kHz localizer separation. The lowest channel operates on an assigned frequency of 108.1 MHz and the highest on an assigned frequency of 111.9 MHz.

3.6.2 Glide Slope frequencies.- In the glide slope mode, each receiver shall be capable of operating on 20 frequencies (one at a time) within the range of 329.3 and 335.0 MHz, based on a 150 kHz glide slope channel separation. The lowest channel operates on an assigned frequency of 329.3 MHz and the highest on an assigned frequency of 335.0 MHz.

3.7 Receiver Unit.- Each receiver shall provide the features and performance characteristics described in the following subparagraphs. A simplified functional block diagram is also provided in Figure 1. (See Part 6 for limitation on the applicability of informational material.)

3.7.1 RF Section.- Operation of the receiver within the frequency bands specified in pagagraph 3.6.1 and 3.6.2, respectively, shall be accomphished by use of a single RF section subdivided into several compartments, as required to comply with the specification requirements.

3.7.1.1 Frequency Band Selection.- Selection of the localizer or glide slope operating frequency band shall be accomplished by the use of two type BNC female chassis receptacles located on the front panel of the receiver in conjunction with a two position toggle selection switch. One receptacle shall be labeled "Localizer Input" and the second receptacle shall be labeled "Glide Slope Input". The input VSWR at the BNC connectors shall not exceed 1.4/1 using a 50 ohm source. The toggle switch, also located on the receiver front panel, shall provide for connection with, or activation of, the circuits associated with the selected input. One position of the switch shall be labeled "Localizer" and the second position shall be labeled "Glide Slope".

3.7.1.2 Frequency Control and Channel Selections.- The receiver shall be of the superheterodyne type, using crystal controlled local oscillators, with provision for selection of any one of three (3) crystal circuits, and other channel sensitive circuits as required, within either the localizer or glide slope frequency band. Channel selection shall be accomplished by a single three (3) position rotary switch located on the receiver front panel. The switch positions shall be labeled "A", "B", and "C". After initial crystal installation and bench tuning on each channel, all performance requirements stated herein shall be met on each selected channel within the respective frequency band.

3.7.1.3 Electrical Requirements.- All electrical connections between the RF section and receiver main frame shall be by means of rack and panel connectors. The signal connection between the RF section and the separate IF amplifier section of the receiver shall be accomplished with coaxial cable and BNC type fittings.

3.7.1.3.1 Local oscillator output frequency.- The local oscillator output frequency shall remain within 0.005% of the design center frequency for operation on the assigned channel over the range of service conditions.

3.7.1.3.2 Oscillator coupled output.- Oscillator, oscillator harmonics and all other spurious outputs shall not exceed one millivolt as measured at the RF input receptacle terminated in 50 ohms.

3.7.1.3.3 Image and IF rejection.- The image and IF rejection shall be at least 60 dB

3.7.1.3.4 Receiver If response characteristics.- The receiver IF response characteristics relative to an input signal at the IF design center frequency shall be as follows. These requirements shall be met over the service conditions.

Frequency	Attenuation
± 30 kHz	6 dB or less
± 100 kHz	60 dB or greater

(These requirements are not intended to prohibit the furnishing of a separate IF design for localizer and glide slope applications respectively, if such is determined to be technically feasible consistent with all other performance requirements. If separate IF designs are furnished, the governing items for the receiver IF response characterisitcs are as follows:

	Frequency	Attenuation
Localizer	± 10 kHz	6 dB or less
	± 100 kHz	60 dB or greater
Glide Slope	± 30 kHz	6 dB or less
	± 300 kHz	60 dB or greater

3.7.1.3.5 Automatic gain control.- The receiver shall employ automatic gain control (AGC) which is operative over the full range of RF input signal levels as specified in 3.5. In addition to providing regulation consistent with the requirements of DDM indicator meter variation with input levels specified hereinafter, the AGC voltage shall be utilized to provide an indication of relative RF input level (3.7.3.4) to the receiver.

3.7.2 Function selector switch.- The function selector switch (S1, Figure 1) shall be located on the front panel of the receiver unit and shall provide the following functions:

Switch Positions	Switch Position Designation	Function "Level" Indicator	Function "% DDM" Indicator
1	BAT CHRG	--	--
2	OFF	--	--
3	BAT VOLT	Battery voltage (red line)	--
4	RF LEVEL	Relative RF	
5	DDM-50	Calibrate (red line)	90 & 150 Hz, DDM
6	DDM-25	same	same
7	DDM-5	same	same

3.7.3 Level indicator circuit requirements.

3.7.3.1 Level meter.- A meter shall be provided on the front panel of the equipment to indicate the following:

(1) Satisfactory Battery voltage level

(2) The relative RF input level

(3) The sum of the individual average levels of the 90 Hz and 150 Hz audio signals.

(4) Correct test signal input level (3.7.5.6) used for DDM circuit calibration.

(5) Correct input signal level (3.7.5.8) received from a fixed monitor detector for the measurement of DDM.

3.7.3.2 Meter scale.- The meter scale shall be marked with 50 equispaced divisions with each fifth mark accentuated. The main dial divisions shall be marked from 0 to 100 in steps of 10. A red line shall be provided at mid-scale deflection for gain adjustment of the linear amplifier, adjustment of the test signal input level (3.7.5.6), adjustment of the audio input signal (3.7.5.8), and to indicate satisfactory battery voltage (3.7.3.3).

3.7.3.3 Battery voltage indication.- When the function selector switch is in Position 3, the equipment shall be operating with the normal battery load. Satisfactory battery voltage shall be indicated by a reading on or above the red line on the level meter.

3.7.3.4 Relative RF input level.- With the function selector switch in Position 4, the level meter shall be indicative of the relative AGC bias level. On-scale AGC readings shall be obtained throughout the RF input levels specified in Paragraph 3.5 by the use of suitable multipliers or a two position meter range selector switch. The meter and AGC circuitry shall be such that on-scale readings, or readings within specified limits separately marked on the level meter scale, will be obtained only when the switch, if provided, is in the correct position. The meter shall deflect from left to right for a corresponding increase in the RF level input to the receiver.

3.7.3.4.1 Calibration charts.- Individual charts depicting calibrated curves of receiver RF input levels versus level meter deflections shall be prepared and supplied for the localizer and glide slope frequencies, respectively for each receiver. The calibration charts shall be installed in the front cover of the receiver, either behind a clear plastic holder or by permanently attached screws with removable wingnuts (see Figure 3). If a meter range selection switch is provided, separate calibration curves shall be furnished for each meter indicating range.

3.7.3.5 Audio signal level indication.- When the function selector switch is in any of the DDM positions (5, 6, or 7), a DC voltage representing the combined level of the individual 90 Hz and 150 Hz signal components shall be connected to the level meter through an appropriate multiplier resistor. The meter shall then be used in conjunction with the amplifier front panel gain control for the adjustment of audio level input to DDM measuring circuits. The DDM accuracy measurements specified hereinafter shall apply after adjustment of the gain control to obtain a red line indication on the level meter.

3.7.4 Linear detector-amplifier.- Linear detection of the AGC controlled IF signal, followed by linear amplification of the detected signal envelope, shall be utilized to provide audio signal components for operation of the DDM measurement circuits and also for test analysis purposes.

3.7.4.1 Gain control.- A front panel control knob labeled "AMP GAIN" shall be provided to compensate for small variation in the input to the linear detector due to imperfect AGC operation.

3.7.4.2 Audio output.- With a standard localizer centering signal (3.2.4) applied to the receiver input, the linear amplifier shall provide not less than 100 millivolts each of 90 Hz and 150 Hz voltage at the audio output test jack (3.7.4.3) with the jack terminated in an external 10,000 ohm resistive load.

3.7.4.3 Audio output test jack.- The audio output test jack shall be located on the receiver front panel and shall be labeled "AUDIO".

3.7.4.4 Effect of load on DDM indication.- With a standard glide slope deviation signal (3.2.5) applied to the receiver input, loading of the audio test jack as specified in 3.7.4.2 shall not alter the DDM indication by more than one scale division (0.01 DDM) on the 0.25 DDM scale.

3.7.4.5 Frequency response.- The frequency response of the linear amplifier and audio output coupler, as measured at the audio output test jack, shall be such that the overall variation in output level does not exceed 0.2 dB between 80 Hz and 160 Hz and does not exceed 2.0 dB between 300 Hz and 3000 Hz.

3.7.4.6 Distortion.- With a standard Glide Slope centering signal (3.2.4) applied to the receiver input terminals, the total harmonic distortion of the 90 Hz and 150 Hz audio output signals, as measured at the audio output test jack, shall not exceed 4% (each harmonic series referenced to its fundamental).

3.7.4.7 Noise level.- With an RF input signal of 25 microvolts modulated with 20% each of 90 Hz and 150 Hz components, the total noise level at the audio output test jack shall not exceed a level that is 26 dB below the level of either fundamental signal component.

3.7.4.8 Audio phase shift.- With a standard Glide Slope centering signal (3.2.4) applied to the receiver input terminals, the phase relationship between the 90 Hz and 150 Hz signals at the audio output test jack shall be within 6 degrees (at 90 Hz) of that existing in the RF signal envelope.

3.7.5 DDM indicator circuit.- The DDM indicator circuit shall consist of a 90 Hz level control, a 150 Hz level control, a 90 Hz filter, a 150 Hz filter, two full wave rectifiers, a DDM indicator, and a range selector switch with appropriate shunts/multipliers. The 90 and 150 Hz components in the output of the audio amplifier shall be separated by the 90 Hz and 150 Hz filters and each resultant component shall be fed into its full-wave rectifier. The output voltages of the rectifiers shall be differentially combined and the resultant DC voltage shall be fed into the DDM indicator to measure the difference in depth of modulation between the 90 Hz and 150 Hz components.

3.7.5.1 Filters.- The 90 Hz and 150 Hz filters shall be combined in a single hermetically sealed case to minimize the effect of ambient temperature differential.

3.7.5.1.1 Frequency response and attenuation.- With the input and output circuits of the 90 Hz and 150 Hz filters properly loaded, the attenuation of each filter (referred to the frequency of maximum response) shall be as follows:

Frequency	Attenuation	
	90 Hz Filter	150 Hz Filter
60 Hz and lower	20 dB or more	35 dB or more
87 to 93 Hz	0.5 dB or less	30 dB or more
145 to 155 Hz	30 dB or more	0.5 dB or less
180 Hz	35 dB or more	20 dB or more
270 Hz and higher	35 dB or more	35 dB or more

The above requirements shall be met over the service condition range of temperature and humidity. Under the same conditions, the outputs at 90 Hz and 150 Hz shall not vary more than ± 0.5 db; neither shall the difference between the outputs of the two filters vary more than ± 0.3 dB. Additionally, the difference between outputs shall not vary more than ± 0.3 dB when the frequencies of the 90 Hz and 150 Hz input signals are respectively increased simultaneously to 93 Hz and 155 Hz and, alternately, decreased to 87 Hz and 145 Hz.

3.7.5.2 90 and 150 Hz level controls.- Two controls, one in the 90 Hz circuit and one in the 150 Hz circuit (see Figure 1) shall be provided for use in the bench calibration of the DDM circuits (3.7.5.6). The controls shall be screwdriver adjustable, locking types mounted on the rear chassis of the receiver.

3.7.5.3 Level control switching.- A three (3) position rotary selector switch, S2, shall be provided (see Figure 1) so that the separate outputs of the 90 Hz and 150 Hz filters may be measured on the DDM indicator. The switch shall be located adjacent to the 90 and 150 Hz level controls (3.7.5.2) on the receiver rear chassis.

3.7.5.4 DDM indicator.- The DDM indicator shall be a zero-center DC microammeter. The pointer shall deflect to the left with 90 Hz predominating and to the right with 150 Hz predominating. The indicator scale shall be marked "90 Hz" and "150 Hz", accordingly. Three (3) ranges shall be provided to produce full scale deflection with DDM values of .05, .25, and.50 respectively. The meter scale shall be graduated into 25 equi-spaced divisions each side of center with every fifth mark accentuated. above the graduations, each accentuated mark shall be numbered to indicate the 0 to .25 DDM full scale range on each side of center. Below the graduations, the accented marks shall be numbered to indicate the 0 to .50 DDM full scale range on each side of center. Scale markings for the .05 DDM range shall not be provided. In addition, two intermediate red line marks shall

be provided at .165 DDM, each side of center, on the 0-.25 DDM scale for use in the bench calibration procedure (3.7.5.6).

3.7.5.5 DDM indicator range. - Selection of the 0 to .05, 0 to .25, and 0 to .50 DDM indicator scale ranges shall be provided by three positions of the function selector switch (S1).

3.7.5.6 Calibration. - Bench calibration of the DDM circuits shall be accomplished by the separate introduction of 90 Hz and 150 Hz test signals from an external audio oscillator (oscillator not required to be furnished under this specification) each at a level to produce a mid-scale reading on the level meter (3.7.3.1(4)) and adjustment of the level controls (3.7.5.2) to produce standard deflections of 0.165 on the 0.25 DDM range. The external 90 Hz/150 Hz test signals shall be connected to the unit via a separate input jack located on the front panel. This jack, which shall be a telephone type to accommodate a type PL-55 plug, shall be labeled "90/150 Hz INPUT". The jack shall be wired so than when an external plug carrying the test signal is introduced, the test signal is connected to the DDM circuits via an audio input level control or the monitor level control (3.7.5.8.1 and Figure 1) and the normal audio input to the DDM circuits is automatically disconnected. The "AUDIO" jack (3.7.4.3) shall, however, remain connected to the input of the DDM circuits for the monitoring of audio voltage. The bench calibration procedure shall not require the use of external test equipment other than the audio oscillator referenced above. After the bench calibration and without subsequent adjustments other than the operational (front panel) adjustment permitted under 3.7.1.2.5 and 3.7.3.5 the accuracy of indicated DDM shall be as specified hereinafter.

3.7.5.7 Accuracy of DDM indications.

3.7.5.7.1 Normal test conditions: Standard test signals. - Under normal test conditions with a standard test signal (3.2.2 or 3.2.3) applied to the receiver input, the accuracy of DDM indications shall be:

a) $\pm$ .005 DDM on the 0.05 DDM scale for standard centering signal (3.2.4)

b) $\pm$ .01 DDM on the 0.25 DDM scale for a standard deviation signal (3.2.5)

c) $\pm$ .03 DDM on the 0.50 DDM scale for a .40 DDM signal (Glide slope only.)

3.7.5.7.2 Service condition: standard test signal. - Under the service conditions the indicated DDM shall not vary from the readings obtained under 3.7.5.7.1 by more than:

a) $\pm$ .005 DDM

b) $\pm$ .010 DDM

c) $\pm$ .020 DDM

for the corresponding input signal conditions.

3.7.5.7.3 Effect of input signal level variation.- Variation of the input signal level throughout the range of RF input levels as specified in 3.5 shall not vary the DDM readings obtained under 3.7.5.7.1 or 3.7.5.7.2 (as applicable) by more than

a) ± .002 DDM

b) ± .005 DDM

c) ± .010 DDM

for the corresponding input signal DDM level.

3.7.5.7.4 Susceptibility to RF fields.-With a standard deviation signal (3.2.5) applied to the respective receiver input receptacle, the effects of impressing simultaneously a signal of the same RF frequency and with the same DDM characteristics, and having an intensity of 1500 millivolts per meter upon the receiver case shall not vary the DDM reading obtained on the 0.25 DDM scale by more than ± .005 DDM.

3.7.5.8 Audio input circuit.- The equipment shall meet the performance requirements specified in the following subparagraphs with an audio input voltage applied to the "90/150 Hz Input" jack (3.7.5.6), from a fixed monitor detector, in the range of .05 volts to 3.0 volts and composed of 90 Hz and 150 Hz components. A coupling capacitor shall be used in the input circuit for DC isolation. (The fixed monitor is part of the ILS and is not to be supplied as part of the equipment specified herein).

3.7.5.8.1 Monitor level control. A control shall be provided to adjust the level (3.7.3.1 and 3.7.3.2) of the incoming demodulated RF (90 and 150 Hz) signal from the fixed monitor detector. This control shall be a continuously adjustable type located on the front panel of the equipment and shall be labeled "MON GAIN".

3.7.5.9 Audio input DDM accuracy.- After bench calibration and without subsequent adjustment other than that of 3.7.5.8.1, the DDM shall read within the values specified below. The following test signals shall be used:

a. Centering signal. A composite 90/150 Hz signal with the 90 Hz and the 150 Hz voltages being equal within ± 0.1 dB.

b. Left and right deviation signal for the .25 DDM scale. A composite 90/150 Hz signal with the ratio of the 90 Hz voltage to the 150 Hz voltage being +7.1 dB and -7.1 dB respectively.

c. Left and right deviation signal for the .5 DDM scale. A composite 90/150 Hz signal with the ratio of the 90 Hz voltage to the 150 Hz voltage being + 16.9 and -16.9 dB respectively.

3.7.5.9.1 Normal test conditions.- Under normal test conditions with test signals a, b, and c applied to the audio input jact the DDM meter shall indicate the following:

a. 0 ± .005 DDM on the .05 DDM scale.

b. .155 ± .01 DDM on the .25 DDM scale

c. .3 ± .03 DDM on the .5 DDM scale

3.7.5.9.2 Service conditions.- Under the service conditions the indicated DDM shall not vary from the readings obtained under 3.7.5.9.1 by more than

a. ± .005 DDM

b. ± .01 DDM

c. ± .020 DDM

for the corresponding input signal conditions.

3.7.5.9.3 Audio level variations.- Under normal test conditions, variation of the audio signal levels of test signals a, b, and c throughout the range of .05 volts to 3.0 volts shall not vary the DDM meter readings obtained under 3.7.5.9.1 by more than

a. ± .001 DDM

b. ± .001 DDM

c. ± .002 DDM

for the corresponding input signal conditions.

3.7.6 Receiver construction.

3.7.6.1 General.- The construction of the receiver unit shall be similar to the sketch shown in Figure 3. The unit shall be designed for portability and shall consist of an aluminum alloy panel-chassis assembly enclosed in an aluminum alloy or magnesium alloy case. The front panel, including all operating controls and indicators, shall be protected when the receiver unit is in transit or in storage by means of a hinged aluminum alloy or magnesium alloy removable cover. The rear of the unit shall be protected by a similar removable cover the inside of which provides for the winding and storage of an AC power cord. Both the front and rear covers shall be secured to the case by means of loose-joint hinges and suitcase type fasteners. The removable covers shall be fitted with neoprene gaskets for weather-proofing of the entire unit when the covers are secured. The front panel shall be secured to the outer case by means of captive, knurled, slotted head thumb screws. Loosening of the thumb screws shall permit the entire unit to be withdrawn from the case thereby providing aeeessibility to all parts of the unit. The outside dimensions of the case proper (with the front and rear removable covers attached) shall not exceed 9 1/2 inches in width, 9 1/2 inches in height, and 10 inches in depth. All corners of the case, front and rear covers, and the front panel, shall be rounded to a minimum radius of 1/16 inch. A metal flange at least 2-3/4 inches in diameter and 3/8 inch thick, tapped for standard photographic tripod mounting,

(1/4 x 20 thread) shall be mounted on the bottom of the cabinet at the gravitiational center for attachment of the unipod (Figure 3). The flange shall be of stainless steel or in lieu thereof, a tapped stainless steel insert shall be provided in the flange.

3.7.6.2 Nominal metal thickness.- Metal thickness shall be adequate to meet the structural strength requirements and shall be a least as great as the following tabulated values:

Case	0.063 inches
Front and rear cover	0.063 inches
Front panel	0.125 inches
Chassis	0.091 inches

3.7.6.3 Carrying handle.- A metal carrying handle shall be affixed to the top of the case.

3.7.6.4 Rubber feet.- Four rubber feet of sufficient height to protect the stainless steel flange shall be mounted on the bottem of the unit. In addition, four rubber feet shall be mounted on the rear cover to allow the unit to be rested on a surface, face up without marring the finish.

3.7.6.5 Finish.- The case, front and rear removable covers and the front panel, shall be finished in smooth gray enamel matching Color No. 16314 of Federal Standard No. 595 (modifies Paragraph 1-3.8.2 of FAA-G-2100/1). However, use of a single designation plate, overlaying the entire front panel and adhered thereto, rather than several individual designation plates is permissible (Modifies FAA-G-2100/1 paragraph 1-3.12.5).

3.7.6.6 Nameplate.- A nameplate, in accordance with FAA-G-2100/1 shall be provided on the removable front cover. The equipment title shall be :

PORTABLE ILS RECEIVER

In addition the equipment title and FAA type designation shall be designated on the receiver front panel.

3.7.7 Receiver power supply.- Power for operation of the receiver shall be provided by an internal power supply consisting of a battery which is the primary power source, and a battery charger/DC power supply network. The battery shall be a commercial type, readily available from two (2) or more sources (Modifies FAA-G-2100/1, paragraph 1-3.16.1). The receiver shall operate within all specification limits when power is supplied by an adequately charged battery or by the charger/DC power supply network regardless of the adequacy of the battery charge (function selector switch, Paragraph 3.7.2, in positions 4,5,6, or 7). With the function selector switch in Position 1 the output the battery charger/DC power supply network shall be applied to the battery so as to comply with Paragraph 3.7.7.3.

3.7.7.1 Battery.- The battery shall be a sealed nickel cadmium type with a capacity such that, when initially in a fully charged condition, it will operate the receiver within specification limits continuously for not less

than eight hours without recharging. The battery specifications, including capacity, charge rate, cut-off voltage, discharge rate, shelf life rate of discharge, and frequency of charging when not in use and the battery replacement procedure shall be included in the equipment instruction book. Access to the battery shall be from the receiver unit rear chassis. Battery removal and replacement shall not require the use of hand tools.

3.7.7.2 Battery Charger/DC power supply constructions.- The battery charger/DC power supply network shall pperate from an 120 volt, 60 Hz, 2 wire AC source and shall consist of a transformer, fuse, indicator light, rectifier, current limiting devices, and an AC line receptacle and power cord (Paragraph 1-3.6.6 of FAA-G-2100/1) for connecting to an external AC power source. The power cord length, including connectors, shall be from four to six feet and shall bb stored within the removable rear cover of the receiver when not in use. The fuse and receptacle shall be mounted on the unit rear chassis and the indicator light on the unit front panel. Supply voltage for the indicator lamp shall not exceed 28 volts (design center) and the light and lamp assembly types shall be selected accordingly from 1-3.16.5.1 of FAA-G-2100/1. The indicator lamp shall be illuminated whenever the battery is being charged or when the unit is operating from the external AC power source. Control of the AC input power shall be accomplished through the function selector switch, S1 (Modifies paragraph 1-3.6.1 of FAA-G-2100/1 by deletion of the requirement for opening the neutral wire).

3.7.7.3 Battery charger/DC power supply characteristics.- With the function selector switch in "Battery Charge" position, the output of the battery charger/DC Power Supply network shall be applied across the battery. The charger circuitry shall be such that a condition of charge which will permit eight hours continuous use of the unit, within all specification requirements, will be reached in no more than sixteen hours following an eight hour period of use (3.7.7.1). Under no condition of discharge shall the charging rate applied to the battery exceed the battery manufacturer's recommended maximum rate; nor shall an indefinite charging period result in any damage to the battery or any other components. With the function selector switch in Positions 4 through 7, the battery charger/DC Power Supply network output will be connected to the receiver unit. Operation of the receiver under this condition will be equivalent to that required with an adequately charged battery.

3.7.8 Weight.- The weight of the receiver unit, with battery installed and with both covers attached, but excluding unipod, cables and antennas, shall not exceed 20 pounds.

3.8 Unipod.- The unipod (see Figure 3) shall be fabricated from aluminum tubing with an outside diameter of 1-1/4 iches, wall thickness of 0.028 inches or more, and shall have a polished, natural metal finish. The bottom end shall be closed by means of a hemispherical cast or machined foot. The top end shall be equipped with a flange and a threaded stud to fit the tripod screw socket (flange) of the bottom of the receiver case (see 3.7.6.1). The stud shall be of stainless steel. The flange shall be the same size as the mating flange on the receiver case. The overall length of the unipod shall be five feet $\pm$1 inch.

3.8.1 Nameplate.- A nameplate shall be provided in accordance with FAA-G-2100/1. The title shall be "UNIPOD".

3.9 Antenna assemblies.-

3.9.1 Localizer antenna.- The localizer receiver antenna supplied with the equipment shall be a half-wave dipole, resonant at the center frequency. Each half of the dipole shall consist of two solid stainless steel rods of approximately equal length assembled with integral threaded fittings to form an equivalent quarter wave length section of constant diameter. The outer end of the assembled dipole elements shall be slightly rounded to remove the sharp edge. The inner end of the assembled dipole elements shall be threaded for attachment to the dipole support. The dipole support shall consist of cylindrical pedestal approximately 16 inches long in a single section or two threaded sections. The bottom end of the pedestal shall have a rectangular, slotted flange, for mounting the assembly on top of the receiver case. The flange shall be fastened to the case by wing nuts or equivalent. A grommeted opening shall be provided near the base of the pedestal for exit of the antenna cable connecting to the receiver RF input receptacle (3.7.1.1). Two separate openings shall be provided near the top of the pedestal directly opposite to each other so that the common centerline of the opening is parallel to the front panel of the receiver with the pedestal correctly attached. These openings shall be provided with threaded fittings, insulated from the pedestal, for the attachment of the dipole elements. A balance-to-unbalance network (balun) consisting of a section of unbalanced coaxial transmission line, and an antenna output cable, consisting of a type RG-223/u cable with a BNC type connector, shall be incorporated in the antenna pedestal assembly. The VSWR of the assembled antenna, as measured at the output connector, shall not exceed 1.4/1 over the localizer frequency band. The antenna assembly shall be capable of disassembly without the use of tools and the individual elements shall be conveniently storeable in the carrying case (3.11).

3.9.2 Glide slope antenna.- The glide slope antenna shall be fixed coaxial-fed dipole which will provide the specified performance when centered approximately 1/4 wavelength in front of a metal reflecting plane 10 inches by 19 inches (see 3.12). The antenna structure shall incorporate a compensating section of unbalanced coaxial transmission line as the balance-to-unbalance network (balun). A flange shall be provided on the wing nuts or base of the antenna for mounting the antenna on the reflecting plane. Mounting dimension shall be as shown on Figure 5. The VSWR of the antenna, when installed on the reflecting plane shall not exceed 1.4 over the frequency band. The antenna output connector shall be a female BNC receptacle (UG-290A/U). The antenna shall be of electroplated brass or aluminum alloy.

3.9.3 Polarization.- The response of the respective antennas to input signals having quadrature polarization with respect to the alignment of the antenna shall be at least 26 dB below that obtained when the RF field and the antenna have the same polarization.

3.10 Interconnecting cables and adapters.- Each set shall consist of the following:

a) One 30-foot length of RG-223/U coaxial cable terminated at both ends with male BNC connector plugs (UG-88C/U).

b) One adapter, type UG-201A/U, (to mate with a type N female receptacle and a type BNC male plug).

c) Two right angle BNC adapters (UG-306A/U).

3.11 Carrying case.- The carrying case shall be constructed of fiber glass, aluminum, or rigid ABS (acrylonytrile-butadiene-styrene) material and shall be a suitcase type configuration with carrying handle. The case shall be compartmentized for storage and transport of each of the items of 3.10 in addition to the following.

1 ea. Localizer antenna and pedestal support (3.9.1)

1 ea. Glide slope antenna (3.9.2)

Each case shall be of identical design and shall provide space for all items whether or not all items are ordered with each receiver.

3.12 Portable glide slope antenna mast.-

3.12.1 General.- The glide slope antenna mast, when assembled on site, shall provide for continuous vertical adjustment of the glide slope antenna height above ground. It shall include, in addition to main structural members and assembly hardware, the ground plane for attachment of the glide slope antenna (3.9.2), a trolley arrangement and nylon rope for raising and lowering the antenna, and a platform for supporting the ILS receiver.

3.12.2 Detailed mechanical requirements.- Each portable mast shall consist of parts equivalent to those indicated in Figures 6,7, and 8.

3.12.3 Mechanical tolerances.- The mechanical tolerances of all parts and assemblies shall be such that all like parts will be interchangeable for all use. All fittings, sections, thumbscrews, etc., shall fit snugly and smoothly. Dimensional tolerances shall in no case exceed 1/64 inch.

3.12.4 Nameplate.- The equipment title shall be "PORTABLE MAST, GLIDE SLOPE". The nameplate shall be attached to the surface opposite the engraved side of Assembly No. 1, Figure 6.

3.12.5 Assembly.- The mast shall be capable of assembly without the necessity for drilling, filing, fitting, or forming of parts.

3.12.6 Documentation.- The instruction book shall include coverage on the assembly, disassembly, and operational use of the antenna mast, including illustrations in sufficient detail to identify each mechanical part. Each part shall be assigned a mechanical part number and shall be listed in the

instruction book parts list. In addition, the contractor shall furnish concurrent with, or prior to the delivery of the first antenna mast assembly, two complete sets of manufacturing drawings (contact prints or equivalent). A set of drawings shall include all the drawings and purchase descriptions necessary for fabricaion or procurement of each item furnished. Drawings shall be submitted for Government inspection for completeness and accuracy prior to acceptance of either equipment or drawings.

3.13 Semiconductor devices.- All active electronic devices shall be semiconductor devices (tubes shall not be used). Diodes and transistors shall be in accordance with FAA-E-2100/3. Micro-electronic devices, if used, shall be in accordance with FAA-G-2100/5. Except in those RF applications where lead lengths prohibit their use, or on printed wiring boards of the plug-in type, transistors and integrated circuits shall be mounted in appropriate holders (modifies 3-3.2 of FAA-G-2100/3).

3.14 Printed wiring.- Printed wiring, if utilized shall be in accordance with FAA-G-2100/4. If printed wiring boards of the plug-in type are utilized (see also 1-3.14.4 of FAA-G-2100/1) they shall be provided with suitable guides and keyed so that they can be inserted only in the correct receptacle and in the correct orientation. Notwithstanding the requirement of Paragraph 1.3.16.3.1 of specification FAA-G-2100/1, the use of one-part printed circuit connectors in accordance with MIL-STD-275C, Paragraph 5.7.4 and Figure 9, is permissible. A single, master keyed extender board shall be provided for extension of any operating board. The extender board shall be stored in a spare slotted guide position within the unit.

4. QUALITY ASSURANCE PROVISIONS

4.1 General.- Quality assurance provisions shall be as specified in section 1-4 of Specification FAA-G-2100/1 and FAA-STD-013a. Except where otherwise specified, all tests shall be performed under normal test conditions as defined in paragraph 1-3.2.22 of FAA-G-2100/1.

4.2 Design qualifications tests.- In addition to those tests specified in Paragraph 1-4.3.2 of FAA-G-2100/1 the following tests shall be conducted.

4.2.1 Design qualification tests under normal test conditions.- The following tests shall be conducted under normal test conditions of temperature and humidity:

Overload Protection (both the localizer and glide slope frequency bands)	3.5.1
Oscillator coupled output (both the localizer and glide slope frequency bands)	3.7.1.2.2
Image and IF rejection (both the localizer and glide slope frequency bands)	3.7.1.2.3

Effect of load on DDM indication	3.7.4.4
Frequency response	3.7.4.5
Distortion	3.7.4.6
Noise level	3.7.4.7
Audio phase shift	3.7.4.8
Frequency response (90 and 150, 87 and 145, 93 and 155 Hz portion)	3.7.5.1.1
Battery charger (Output regulation with new and discharged battery, at 102, 120 and 138 VAC)	3.7.7.3
Battery charger (8 hour discharge, 16 hour charge, 8 hour discharge)	3.7.7 and 3.7.7.3
Polarization (each antenna type)	3.9.3
Interchangeability and assembly (3 sets of randomly selected parts)	3.12.3 and 3.12.5
Susceptibility to RF fields	3.7.5.7.4

4.2.2 Design qualification under the service conditions of temperature and humidity.- The following tests shall be conducted in accordance with the procedures of Paragraph 1-4.3.3.2 of FAA-G-1200/1.

Local oscillator stability (both the localizer and glide slope frequency bands)	3.7.1.2.1
IF response (both the localizer and glide slope frequency bands, unless common IF design is furnished).	3.7.1.2.4
Frequency response	3.7.5.1.1

4.3 Type tests.-

4.3.1 Type tests under normal test conditions.-

Tuning range (108.1, 110.1, and 111.9 MHz)	3.6.1
Tuning range (329.3, 332.0 and 335.0 MHz)	3.6.2
Input VSWR (108.1, 110.1 and 111.9 MHZ)	3.7.1.2
Input VSWR (329.3, 332.0 and 335.0 MHZ)	3.7.1.2

4.3.2 Type test under the service conditions of temperature and humidity.- The following test shall be conducted in accordance with procedures of Paragraph 1-4.12 of FAA-G-2100/1 except that

a) Adjustment of the gain control (3.7.3.5) is permitted before each observation.

b) An equivalent external power source may be used in lieu of the internal receiver battery.

Accuracy of DDM indication (both the localizer and glide slope frequency bands)	3.7.5.7.1 3.7.5.7.2 and 3.7.5.7.3
Audio input DDM accuracy	3.7.5.9.2

4.4 Production tests.- The following production tests shall be performed:

Battery voltage indication	3.7.3.3
Calibration charts	3.7.3.4
Audio output	3.7.4.2
Frequency response	3.7.5.1.1
Calibration	3.7.5.6
DDM Accuracy (both the localizer and glide slope frequency bands)	3.7.5.7.1 3.7.5.7.3
Battery charger (operational test with charged battery and discharged battery)	3.7.7.3
Antenna VSWR (108.1, 110.1 and 111.9 MHz)	3.9.1
Audio input DDM accuracy	3.7.5.9.1 and 3.7.5.9.3
Antenna VSWR (329.3, 332.0 and 335.0 MHZ)	3.9.2

5. PREPARATION FOR DELIVERY

5.1 General.- Unless otherwise specified in the contract, the equipment shall be prepared for domestic shipment in accordance with the following sub-paragraphs.

5.2 Preservation and packing.- Preservation and packing shall be in accordance with Specification MIL-E-17555, Level A.

5.3 Packing.- Packing shall be in accordance with Specification MIL-E-177555, Level B.

5.4 Marking.- Each package and shipping container shall be durably and legibly marked with the following information:

Name of Item and FA Type Designation

Serial Number(s)

Quantity

Contract Number

Federal Stock Number

Gross Weight of Container

Manufacturer's Name

6. NOTES

6.1 Typical design.- Figures 1 through 8 are sketches of a typical equipment design. These figures are furnished for informational purposes only and any reliance placed by the contractor on the information contained in these figures is wholly at his own risk.

* * * * * * * * * *

FOR FIGURES 1 TO 8, SEE PAGES 21 TO 31

ATTACHED FOLLOWING

Page 25: Drawings D-15068-1, -2, and -3.

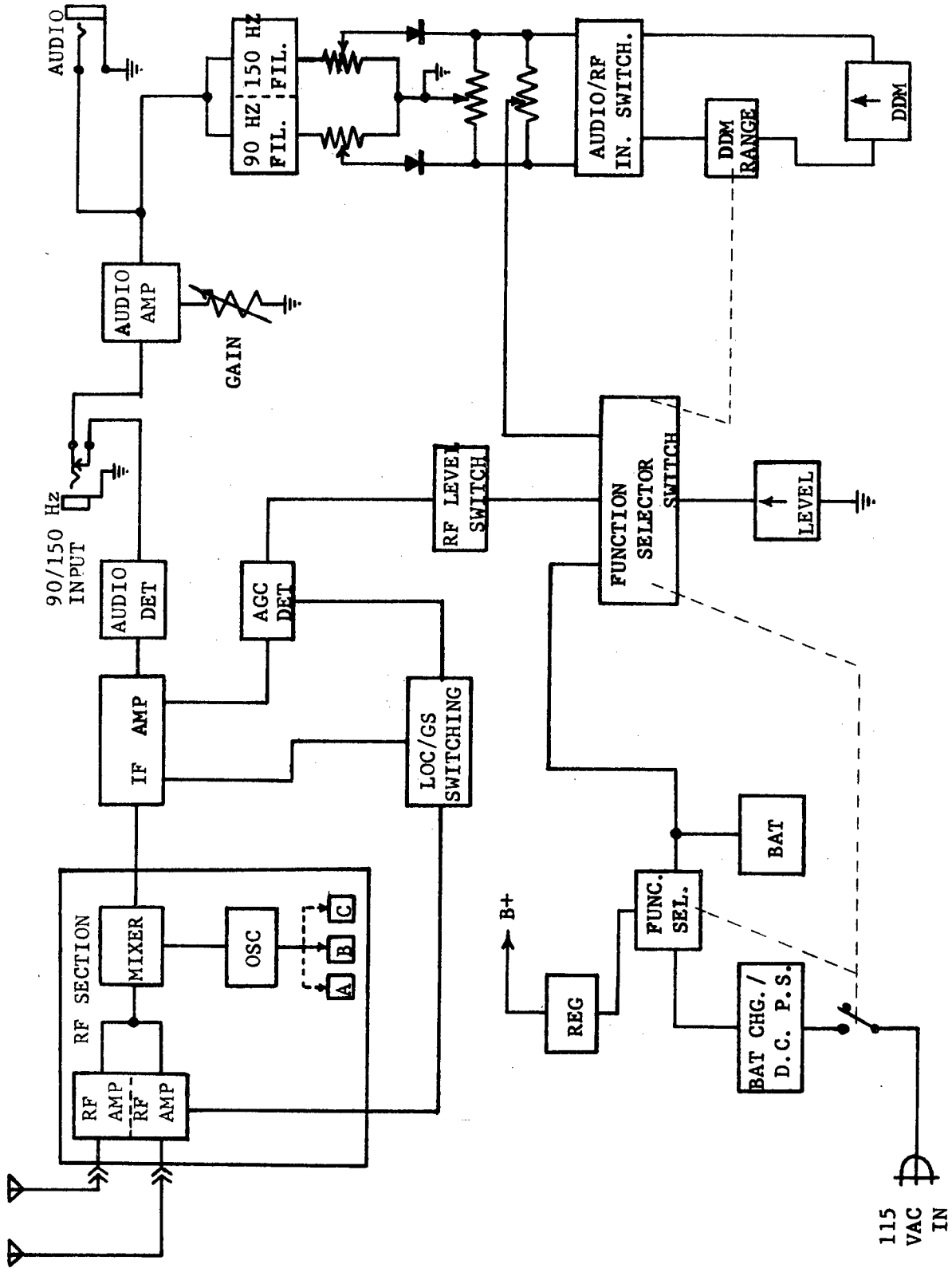
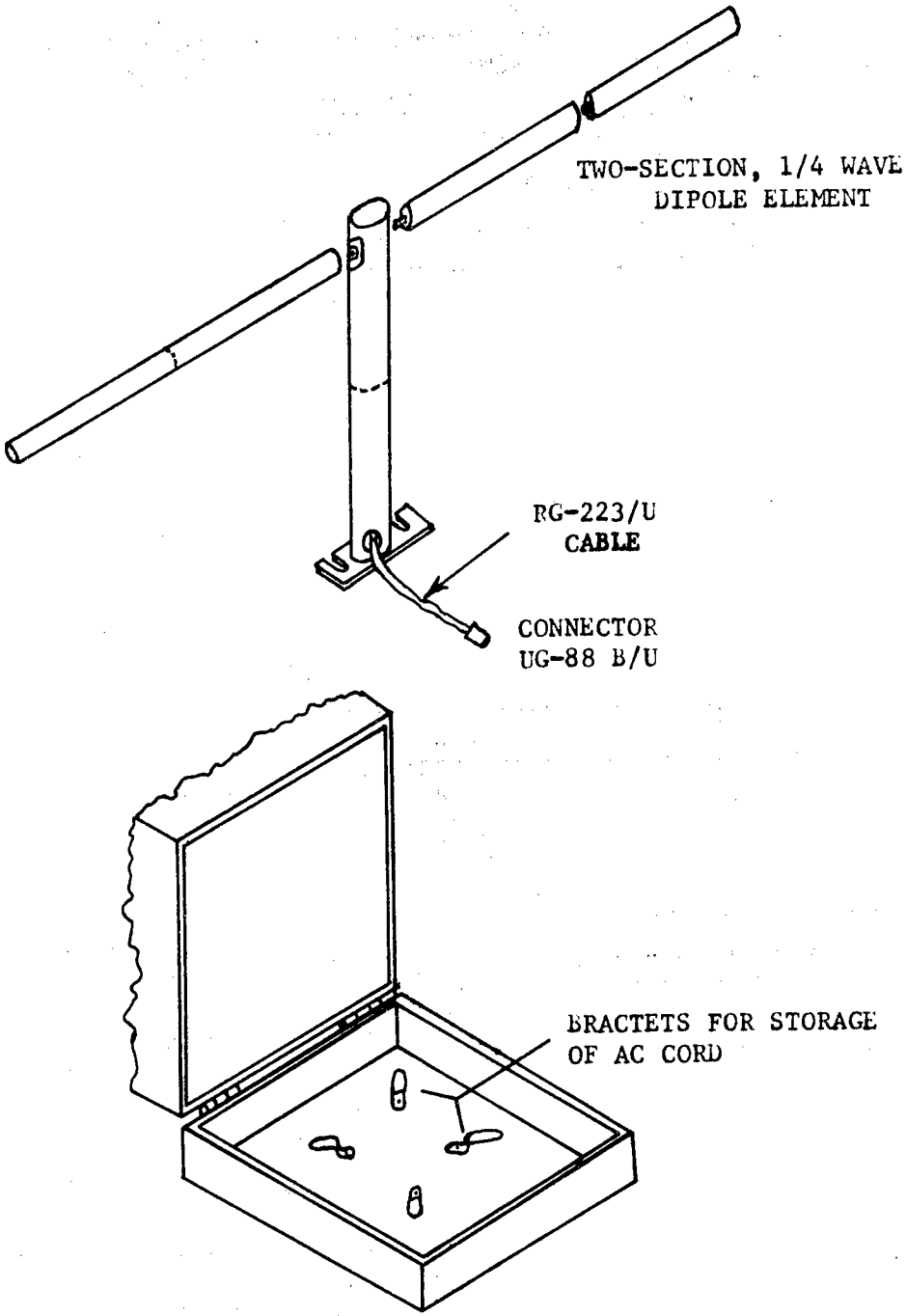
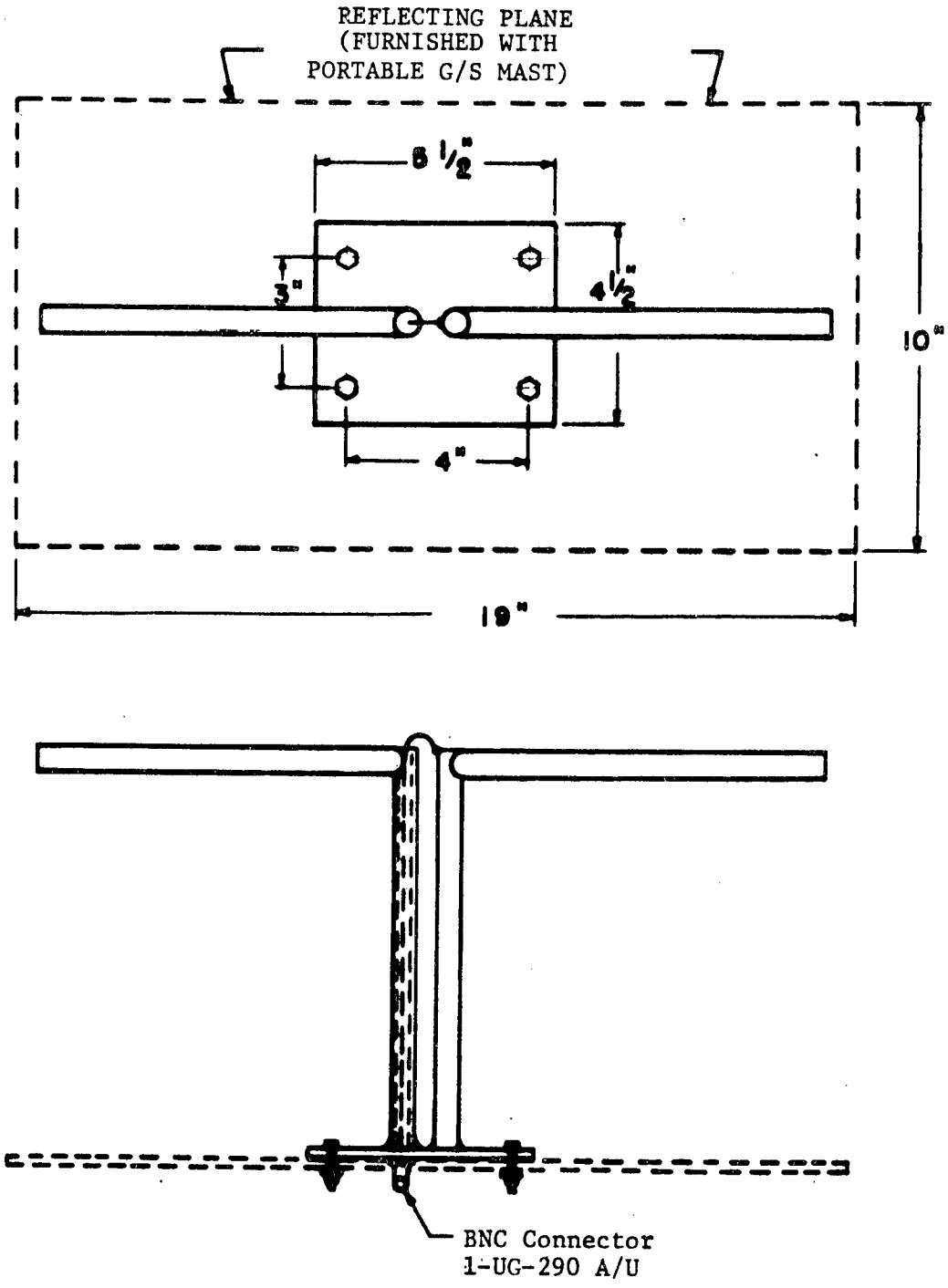


FIGURE 1: PORTABLE ILS RECEIVER BLOCK DIAGRAM



LOCALIZER ANTENNA AND
REAR COVER

FIRGURE 4



GLIDE SLOPE ANTENNA
FIGURE 5

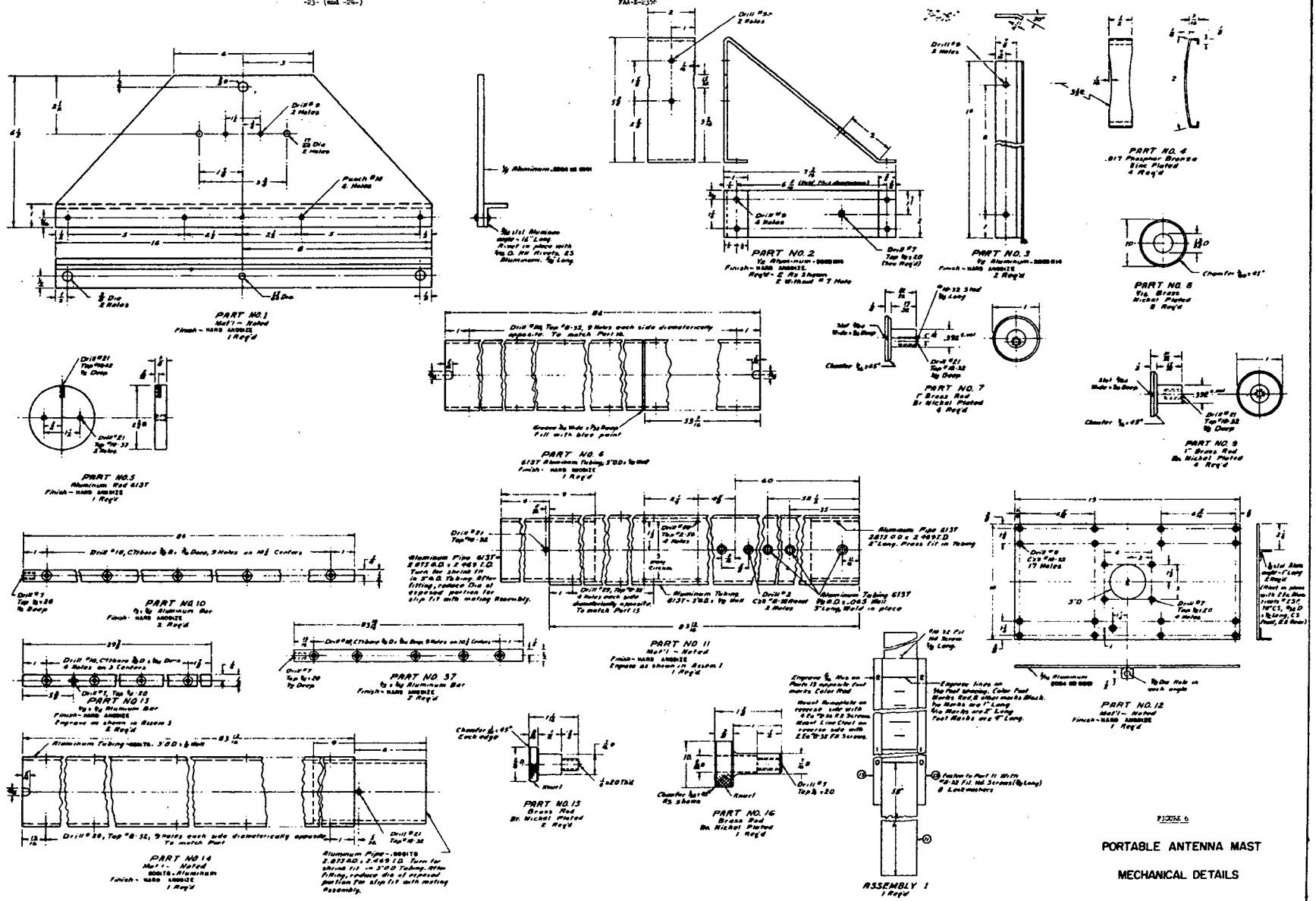
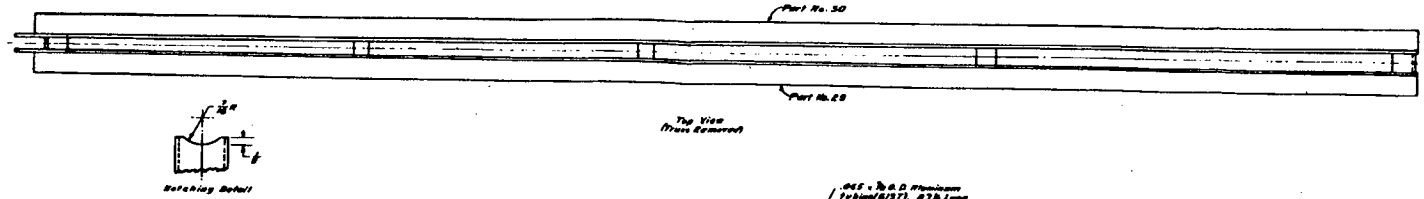


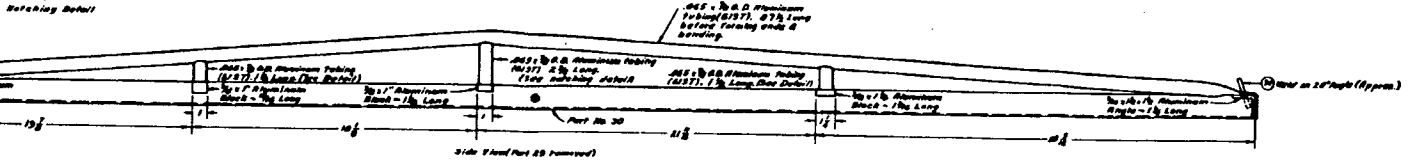
FIGURE 6

PORTABLE ANTENNA MAST

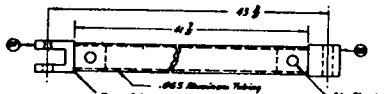
MECHANICAL DETAILS

FILE: D-15068-1



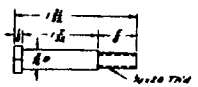


SUB-ASSEMBLY "B"
Welded assembly
3 Req'd

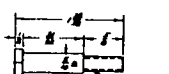


SUB-ASSEMBLY "C"
3 Req'd

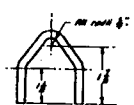
PART NO. 31
Thd Hex.
STAINLESS STEEL
3 Req'd



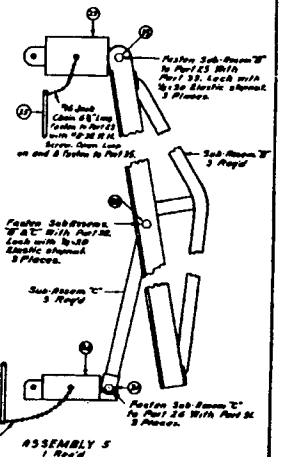
PART NO. 32
Thd Hex.
STAINLESS STEEL
3 Req'd



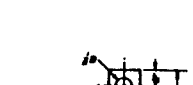
PART NO. 33
Thd Hex.
STAINLESS STEEL
3 Req'd



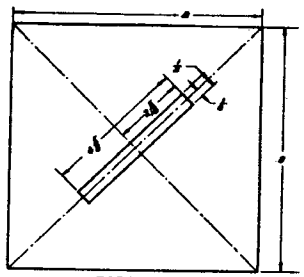
PART NO. 34
Aluminum Rod - .250
3 Req'd



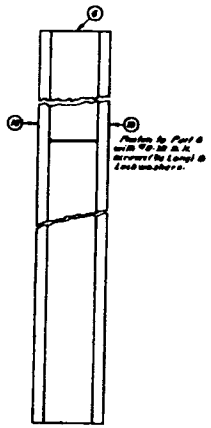
ASSEMBLY 5
1 Req'd



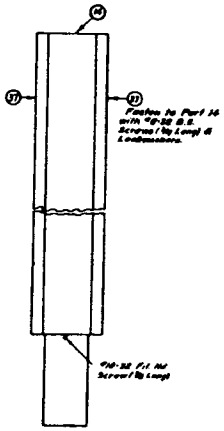
PART NO. 35
Rounded off end of rod
3 Req'd



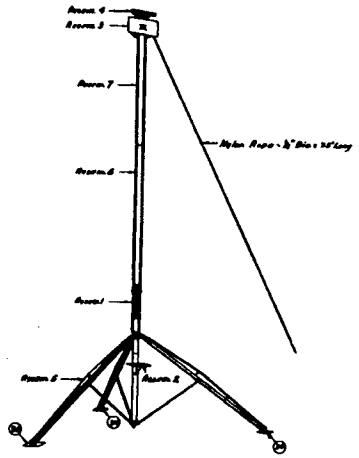
PART NO. 36
Aluminum
3 Req'd



ASSEMBLY 6
1 Req'd



ASSEMBLY 7
1 Req'd



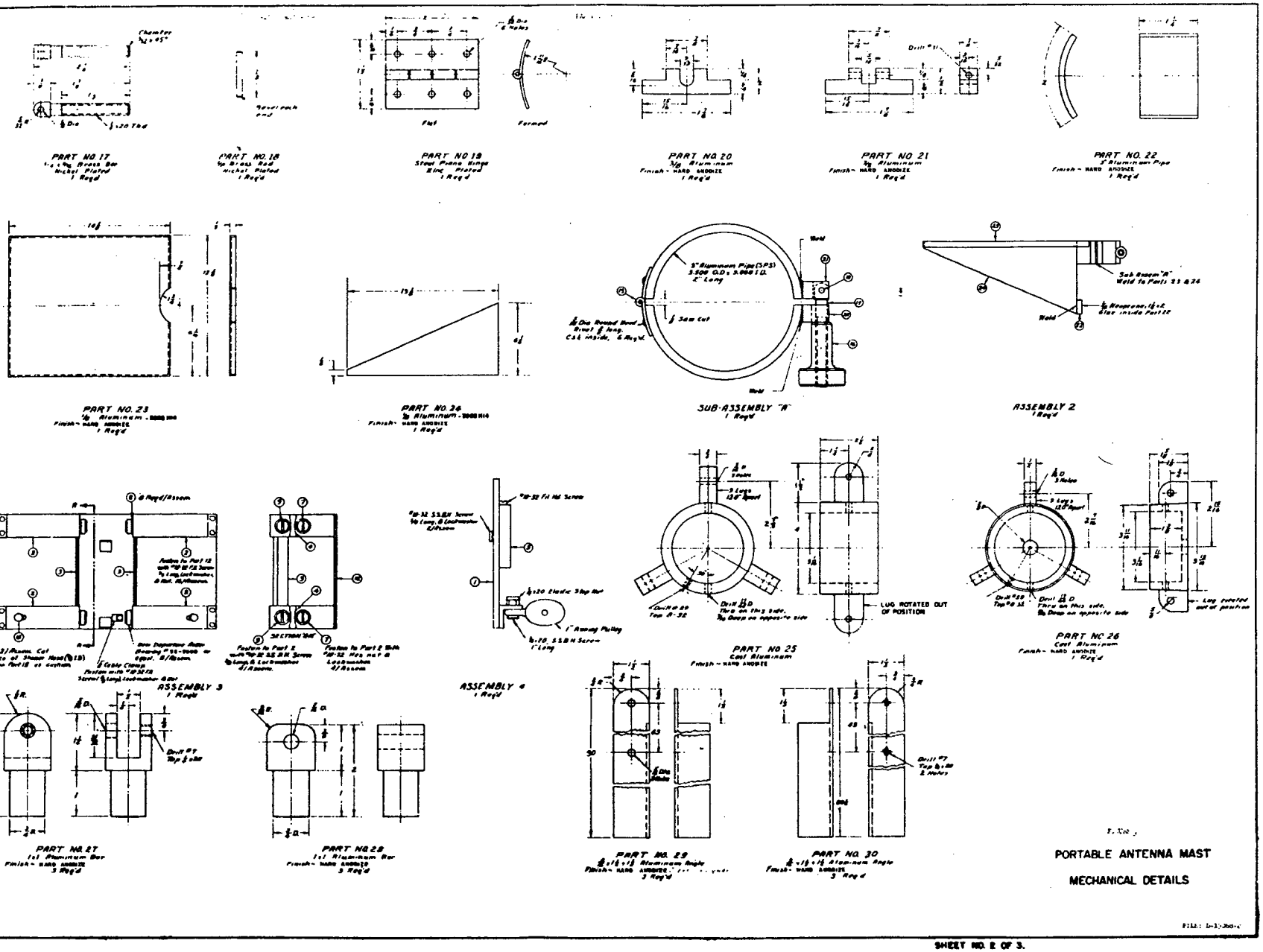
Major Assembly

FIGURE 8

PORTABLE ANTENNA MAST

MECHANICAL DETAILS

FILE: D-15068-3



PORTABLE ANTENNA MAST

MECHANICAL DETAILS